CLAIMS

What is claimed is:

1. An apparatus in an internal combustion engine having a rotatable element that eccentrically moves at least one roller lifter to alter the phasing of the at least one roller lifter engaging with a cam, the apparatus comprising:

a constraining mechanism having at least one end member and at least two interior members connected to said at least one end member; and

at least one stationary block which slidably receives a one of said at least one end member allowing fore-and-aft movement of said constraining mechanism in cooperation with a first roller lifter in a first direction;

wherein said at least two interior members engage said first roller lifter to allow movement of said first roller lifter in a second direction to said first direction such that when the rotatable element eccentrically moves said first roller lifter, said first roller lifter is prevented from rotating about a longitudinal axis of said first roller lifter.

2. The apparatus according to claim 1 wherein said at least two interior members each engage a one of two flat surfaces of said first roller lifter to allow said movement in said second direction.

3. The apparatus according to claim 2 wherein said at least two interior members are substantially parallel to each other, and said two flat surfaces of said first roller lifter are substantially parallel to each other.

4. The apparatus according to claim 1 wherein said first direction and said second direction range from being substantially perpendicular to each other to an orientation not too close to parallel such that the at least one roller lifter becomes constrained from moving eccentrically while being prevented from rotating about said longitudinal axis.

5. The apparatus according to claim 1 further comprising:

a second roller lifter aligned with said first roller lifter; and

an additional pair of interior members connected to said at least one end member, wherein said additional pair of interior members each engage a one of two flat surfaces of said second roller lifter to allow movement of said second roller lifter in said second direction, and said second roller lifter is prevented from rotating about a longitudinal axis of said second roller lifter.

6. The apparatus according to claim 5 wherein said additional pair of interior members are substantially parallel to each other, and said two flat surfaces of said second roller lifter are substantially parallel to each other.

7. The apparatus according to claim 1 wherein said at least two interior members each have a slot, and further wherein said first roller lifter has two locating pins extending from opposite sides of said first roller lifter and perpendicular to said longitudinal axis of said first roller lifter, wherein each of said two locating pins engages with a one of said slots of said at least two interior members to allow said movement of said first roller lifter in said second direction.

8. The apparatus according to claim 1 wherein each of said at least two interior members have an engaging pin, and further wherein said first roller lifter has a first groove and a second groove located on opposite sides of said first roller lifter from each other and parallel to said longitudinal axis of said first roller lifter, wherein one of said engaging pins of said at least two interior members engages with said first groove and an other of said engaging pins of said at least two interior members engages with said second groove in said first roller lifter to allow said movement of said first roller lifter in said second direction.

9. An apparatus in an internal combustion engine having a rotatable element that eccentrically moves at least one roller lifter to alter the phasing of the at least one roller lifter engaging with a cam, the apparatus comprising:

a constraining mechanism having at least one end member and at least one interior member connected to said at least one end member;

at least one stationary block which slidably receives a one of said at least one end member allowing fore-and-aft movement of said constraining mechanism in cooperation with a first roller lifter in a first direction; and

a spring biased against said at least one interior member;

wherein said spring and said at least one interior member engage said first roller lifter to allow movement in a second direction to said first direction such that when the rotatable element eccentrically moves said first roller lifter, said first roller lifter is prevented from rotating about a longitudinal axis of said first roller lifter.

10. The apparatus according to claim 9 wherein said at least one interior member engages at least one flat surface of said first roller lifter to allow movement in said second direction.

11. The apparatus according to claim 9 wherein said first direction and said second direction range from being substantially perpendicular to each other to an orientation not too close to parallel such that the at least one roller lifter becomes constrained from moving eccentrically while being prevented from rotating about said longitudinal axis.

12. The apparatus according to claim 9 further comprising:

a second roller lifter aligned with said first roller lifter; and

an additional interior member connected to said at least one end member, wherein said additional interior member engages a flat surface of said second roller lifter to allow movement in said second direction, and said second roller lifter is prevented from rotating about a longitudinal axis of said second roller lifter.

13. A method for controlling the orientation of at least one roller lifter in an internal combustion engine having a rotatable element that eccentrically moves the at least one roller lifter to alter the phasing of the at least one roller lifter engaging with a cam, the method comprising:

(a) slidably receiving a constraining mechanism in at least one stationary block, wherein said constraining mechanism in cooperation with a first roller lifter is only allowed to move fore-and-aft in a first direction;

(b) engaging at least two interior members of said constraining mechanism with said first roller lifter, wherein said first roller lifter is allowed to move in cooperation with said constraining mechanism in a second direction to said first direction;

(c) eccentrically moving in said first and second directions said first roller lifter with the rotatable element engaged with said first roller lifter; and

(d) preventing said first roller lifter from rotating about a longitudinal axis of said first roller lifter through the cooperation of said first roller lifter with said constraining mechanism.

14. A method according to claim 13 wherein step (a) further comprises:

slidably receiving a first end member of said constraining mechanism in a first of said at least one stationary blocks; and

slidably receiving a second end member of said constraining mechanism in a second of said at least one stationary blocks.

15. A method according to claim 13 wherein step (b) further comprises:

engaging a first of said at least two interior members of said constraining mechanism with a first flat surface of said first roller lifter; and

engaging a second of said at least two interior members of said constraining mechanism with a second flat surface of said first roller lifter;

wherein said first flat surface and said second flat surface are substantially parallel to each other.

16. A method according to claim 13 wherein said first direction and said second direction range from being substantially perpendicular to each other to an orientation not too close to parallel such that the at least one roller lifter becomes constrained from moving eccentrically while being prevented from rotating about said longitudinal axis.

17. A method according to claim 13 further comprising:

engaging at least two additional interior members of said constraining mechanism with a second roller lifter aligned with said first roller lifter, wherein said second roller lifter is allowed to move in said second direction;

eccentrically moving in said first and second directions said second roller lifter with the rotatable element engaged with said second roller lifter; and

preventing said second roller lifter from rotating about a longitudinal axis of said second roller lifter through the cooperation of said second roller lifter with said at least two additional interior members of said constraining mechanism.

18. A method according to claim 13 wherein step (b) further comprises:

engaging a slot within a first of said at least two interior members of said constraining mechanism with a first locating pin on said first roller lifter; and

engaging a slot within a second of said at least two interior members of said constraining mechanism with a second locating pin on said first roller lifter;

wherein said first locating pin and said second locating pin extend from opposite sides of said first roller lifter.

19. A method according to claim 13 wherein step (b) further comprises:

engaging an engaging pin within a first of said at least two interior members of said constraining mechanism with a first groove on said first roller lifter; and

engaging an engaging pin within a second of said at least two interior members of said constraining mechanism with a second groove on said first roller lifter;

wherein said first groove and said second groove are located on opposite sides of said first roller lifter and parallel to said longitudinal axis of said first roller lifter.

20. A method for controlling the orientation of at least one roller lifter in an internal combustion engine having a rotatable element that eccentrically moves the at least one roller lifter to alter the phasing of the at least one roller lifter engaging with a cam, the method comprising:

(a) slidably receiving a constraining mechanism in at least one stationary block, wherein said constraining mechanism in cooperation with a first roller lifter is only allowed to move fore-and-aft in a first direction;

(b) engaging at least one interior member of said constraining mechanism with said first roller lifter;

(c) biasing a spring against said at least one interior member, wherein said first roller lifter is allowed to move in cooperation with said constraining mechanism in a second direction to said first direction;

(d) eccentrically moving in said first and second direction said first roller lifter with a rotatable element engaged with said first roller lifter; and

(e) preventing said first roller lifter from rotating about a longitudinal axis of said first roller lifter through the cooperation of said first roller lifter with said constraining mechanism.

21. A method according to claim 20 wherein step (a) further comprises:

slidably receiving a first end member of said constraining mechanism in a first of said at least one stationary blocks; and

slidably receiving a second end member of said constraining mechanism in a second of said at least one stationary blocks.

22. A method according to claim 20 wherein step (b) further comprises:

engaging said at least one interior member of said constraining mechanism with a flat surface of said first roller lifter.

23. A method according to claim 20 wherein said first direction and said second direction range from being substantially perpendicular to each other to an orientation not too close to parallel such that the at least one roller lifter becomes constrained from moving eccentrically while being prevented from rotating about said longitudinal axis.

24. A method according to claim 20 further comprising:

engaging at least one additional interior member of said constraining mechanism with a second roller lifter aligned with said first roller lifter, wherein said second roller lifter is allowed to move in said second direction;

eccentrically moving in said first and second directions said second roller lifter with the rotatable element engaged with said second roller lifter; and

preventing said second roller lifter from rotating about a longitudinal axis of said second roller lifter through the cooperation of said second roller lifter with said at least one additional interior member of said constraining mechanism.

25. An apparatus in an internal combustion engine having a rotatable element that eccentrically moves at least one roller lifter to alter the phasing of the at least one roller lifter engaging with a cam, the apparatus comprising:

a first constraining mechanism having a deformable member, said deformable member further comprising:

a first end which pushes against a flat surface of a first roller lifter;

wherein said constraining mechanism allows fore-and-aft movement of said first roller lifter in a first direction coincident with the deflection of said deformable member, and allows movement of said first roller lifter in a second direction to said first direction such that when the rotatable element eccentrically moves said first roller lifter, said first roller lifter is prevented from rotating about a longitudinal axis of said first roller lifter.

26. The apparatus according to claim 25 wherein said first constraining mechanism further comprises:

a base; and

a second end of said deformable member attached to said base;

wherein said base is attached to the internal combustion engine.

27. The apparatus according to claim 25 wherein said first direction and said second direction range from being substantially perpendicular to each other to an orientation not too close to parallel such that the at least one roller lifter becomes constrained from moving eccentrically while being prevented from rotating about said longitudinal axis.

28. The apparatus according to claim 25 further comprising:

a second roller lifter aligned with said first roller lifter; and

a second constraining mechanism having a deformable member having a first end which pushes against a flat surface of said second roller lifter;

wherein said second constraining mechanism allows fore-and-aft movement of said second roller lifter in said first direction coincident with the deflection of said deformable member, and allows movement of said second roller lifter in said second direction such that when the rotatable element eccentrically moves said second roller lifter, said second roller lifter is prevented from rotating about a longitudinal axis of said second roller lifter.

29. The apparatus according to claim 28 wherein said second constraining mechanism further comprises:

a base; and

a second end of said deformable member attached to said base;

wherein said base is attached to the internal combustion engine.

30. A method for controlling the orientation of at least one roller lifter in an internal combustion engine having a rotatable element that eccentrically moves the at least one roller lifter to alter the phasing of the at least one roller lifter engaging with a cam, the method comprising:

(a) attaching a first constraining mechanism to the internal combustion engine;

(b) engaging a first end of a deformable member of said first constraining mechanism with a flat surface of a first roller lifter, wherein said first roller lifter, in cooperation with said first constraining mechanism is allowed to move fore-and-aft in a first direction coincident with the deflection of said deformable member, and is allowed to move in a second direction to said first direction;

(c) eccentrically moving in said first and second directions said first roller lifter with the rotatable element engaged with said first roller lifter; and

(d) preventing said first roller lifter from rotating about a longitudinal axis of said first roller lifter through the cooperation of said first roller lifter with said first constraining mechanism.

31. A method according to claim 30 wherein step (a) further comprises:

attaching a base of said first constraining mechanism to the internal combustion engine; and

attaching a second end of said deformable member of said first constraining mechanism to said base.

32. A method according to claim 30 wherein said first direction and said second direction range from being substantially perpendicular to each other to an orientation not too close to parallel such that the at least one roller lifter becomes constrained from moving eccentrically while being prevented from rotating about said longitudinal axis.

33. A method according to claim 30 further comprising the steps of:

(e) repeating steps (a) through (d) for a second constraining mechanism having a first end of a deformable member engaged with a flat surface of a second roller lifter.

34. A method according to claim 33 further comprising:

attaching a base of said second constraining mechanism to the internal combustion engine; and

attaching a second end of said deformable member of said second constraining mechanism to said base.